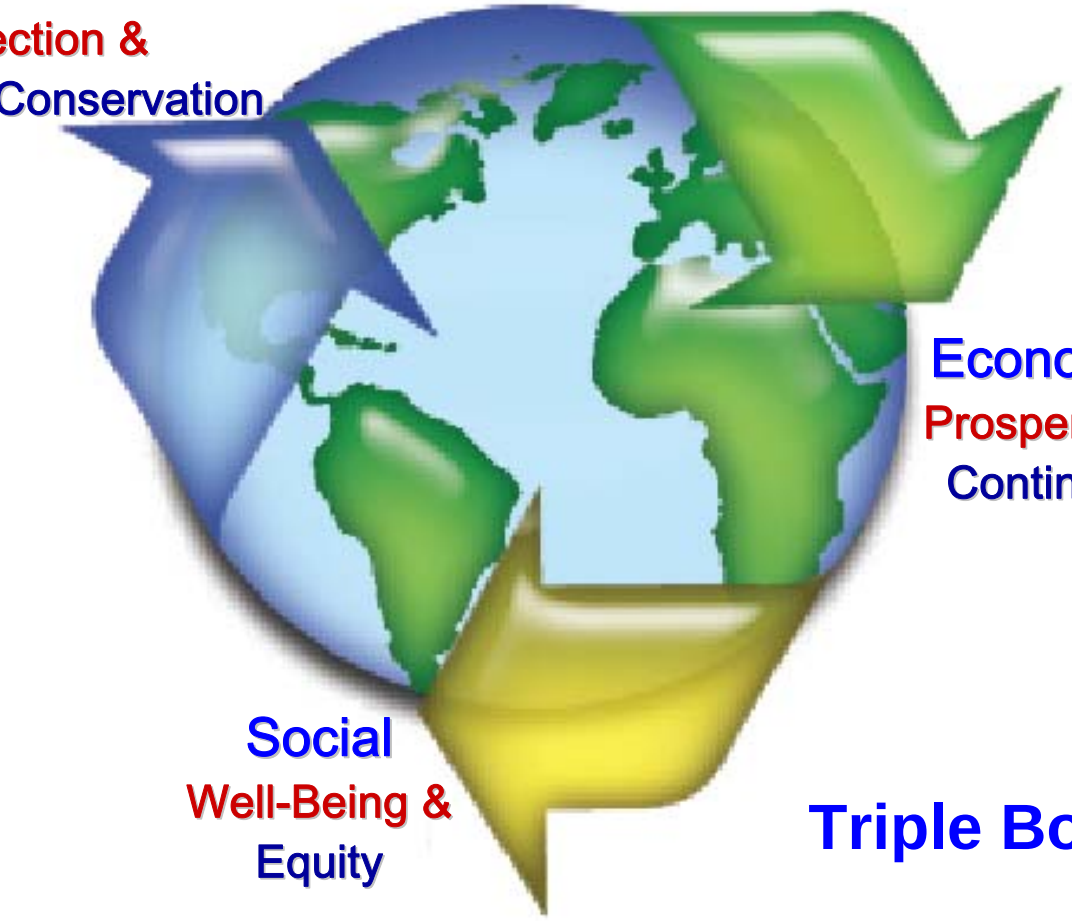
Sustainable Design in Remediation Projects

Ann Rosecrance and Kristina McCurdy
Conestoga-Rovers & Associates
www.CRAworld.com

SUSTAINABLE DESIGN & IMPLEMENTATION



Triple Bottom Line

SUSTAINABLE DESIGN & IMPLEMENTATION(continued)

- Sustainable design in remediation projects is the systematic, balanced planning and management of risks from an activity's broader impact on environmental, economic, and social developments.

- Site design should account for risk reductions, local plant/animal community vitality, conservation of resources, prudent consumption within and greening of the supply chain, waste reduction, overall process/operational efficiency, and long-term stewardship and care factors.

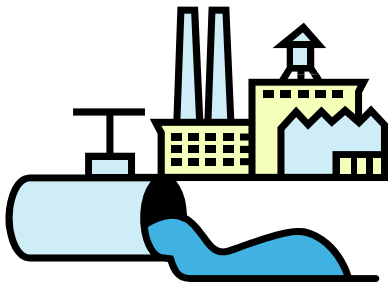
SUSTAINABLE DESIGN & IMPLEMENTATION(continued)

- Project implementation and profits should be achieved in a manner that leaves the Earth healthy and safe, ensuring cost-effectiveness and technical feasibility.

- Project operations should enrich not deprive a community. Community engagements and partnerships are socially responsible behaviors.

SITE REMEDIATION PROCESS

CONTAMINATED SITE

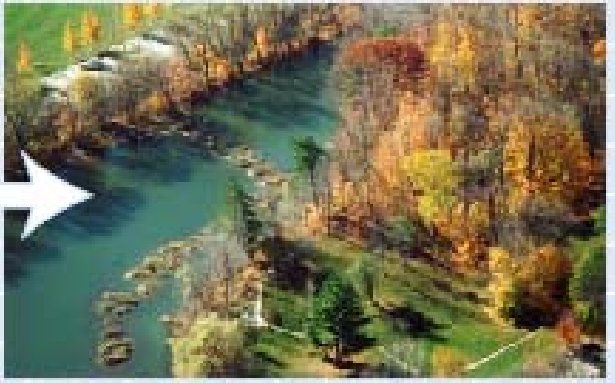


INPUTS

- Energy Supply
- Water Supply
- Transportation and Motion
- Materials and Supply Chain

Remediation Project

REMEDIATED SITE



POTENTIAL BYPRODUCTS

- Land Use (Built & Natural Spaces)
- Transportation Hazards
- Occupational Risks
- Reduction in Biodiversity & Ecosystems
- Releases to Environment
- Waste Generation
- Waste Disposal
- Noise

INPUTS/RESOURCES

Energy

Energy is consumed within site operations. While primarily fuel and electricity, other energy sources such as solar and wind can also be utilized.

Biomass

Plant matter such as trees, grasses, agricultural crops or other biological material can be used as a solid fuel, or converted into liquid or gaseous forms, for the production of electric power, heat, or fuels.

Soil Reuse

Impacted soil may have characteristics that favor after market use (e.g., BTU value, construction, road base, or mineral content).

Water Reuse

Freshwater consumption should be minimized. Water can be reclaimed for beneficial uses such as irrigation, hydro-seeding, and as a cooling medium for remediation technologies.

INPUTS/RESOURCES
(continued)

- Solar
- Solar Wind
- Wave

Solar energy can be used to either heat a fluid (air, water, glycol) or to generate electricity (photovoltaics). Heated fluids can be used as sources of heat to drive other processes. Solar electricity can be used to power remote operations.

Solar and wind used together to generate electricity, known as a hybrid system, can provide more total electricity. Solar photovoltaics used alone are limited in some locations to peak production during summer months and daylight hours. Introduction of wind energy effectively reduces the diurnal energy production cycles and provides more continuous power for remote operations.

In areas where sufficient tidal energy exists, electricity can be produced to power remote operations. Unlike solar and wind power, the diurnal cycles of waves is limited, thereby ensuring more continuous power than solar and wind power.

INPUTS/RESOURCES
(continued)

Geothermal

Geothermal energy involves extracting heat from the ground during winter months and shedding excess heat to the ground during summer months. Geothermal energy allows remote operations with a heavy reliance on heated fluids to operate more efficiently and limit the use of fossil fuels.

Landfill Gas

The use of landfill gas can provide continuous power to drive reciprocating engines, as well as replace or reduce the amount of natural gas used at a particular facility. Landfill gas utilization must occur in specific environments that include a properly engineered and designed landfill, with sufficient organic matter for production of landfill gas. Depending on the specific operation, some cleaning of the landfill gas may be required to remove hydrogen sulfide and water vapor.

INPUTS/RESOURCES
(continued)

- Biological
- Land Reuse

Nature-based models will take on increased importance in the management of biological resources and ecosystems.

Affected areas can be redeveloped as Brownfields properties for multi-purpose use. One acre of redeveloped Brownfields property preserves 4.5 acres of open space land.
Source: http://www.gwu.edu/%7Eeem/Brownfields/project_report/report.htm

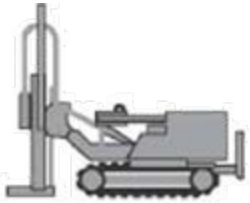
BYPRODUCTS OF REMEDIATION PROJECTS

- Greenhouse Gases
- Particulates
- Light
- Noise
- Waste
- Wastewater

BYPRODUCTS OF REMEDIATION PROJECTS (continued)

Greenhouse Gases – Direct greenhouse gas emissions, such as CO_2 and CH_4, are primarily combustion byproducts from internal combustion engines in vehicles and remediation equipment.

Bulldozer - *52.0 kg CO_2/hr*



Drill Rig - *10.0 kg CO_2/hr*

Dump Truck - *49.4 kg CO_2/hr*

Tractor Trailor - *4.86 kg CO_2/mile*

Excavator - *39.0 kg CO_2/hr*

Diesel Heavy Truck - *1.48 kg CO_2/mile*

Backhoe - *22.3 kg CO_2/hr (62.4 kg CO_2/hr for front end loader use)*

Gas Light Truck - *0.64 kg CO_2/mile*

Estimated emissions factors based on Greenhouse Gas Protocol, www. ghgprotocol.org/

BYPRODUCTS OF REMEDIATION PROJECTS (continued)

Particulates – Primary particulates are emitted from unpaved roads or fires. Wind-blown dust from construction sites and other land areas where water or plants have been removed can contribute significantly to particulate pollution.

Secondary particulates can be formed from SOx and NOx emissions which are byproducts of human activities, such as the burning of fossil fuels in vehicles and remediation equipment.

BYPRODUCTS OF REMEDIATION PROJECTS (continued)

Noise – Engines, turbines, pumps, and compressors all have the potential to generate noise.

Light – Lighting, if needed for night work.

BYPRODUCTS OF REMEDIATION PROJECTS (continued)

Waste – Waste generation and landfill disposal activities can adversely impact air pollution.

Wastewater – Wastewater generated by site operations, including “produced water.”

ECOSYSTEM & BIODIVERSITY MODELS

ECOSYSTEM & BIODIVERSITY MODELS(continued)

Soil Conservation – Soil conservation is an important environmental activity. Soil can act as a carbon sink through natural carbon sequestration which offsets greenhouse gas emissions. Minimizing topsoil compaction can prevent soil losses from surface runoff and wind erosion.

ECOSYSTEM & BIODIVERSITY MODELS (continued)

Reforestation –
Planting or conservation of trees allows natural carbon sequestration and can improve habitat suitability for wildlife. Reforestation can sequester 0.3 - 2.1 metric tons of carbon per acre per year for approximately 90 - 120 years.
Source:
http://www.epa.gov/sequestration/rates.html

ECOSYSTEM & BIODIVERSITY MODELS(continued)

Biodiversity –
Imitating nature's design principles and processes can effectively aid in cleanup solutions and sustainable planning. Wetlands can act as nature's purifier and can efficiently restore affected areas. Natural occurring bacteria can be used to treat and remediate groundwater.

SUSTAINABLE REFERENCES

SUSTAINABILITY PRINCIPLES

"Valdez Principles for Site Design," developed by Andropogon Associates, Ltd – http://www.ashland.or.us/Page.asp?NavID=614

12 Principles of Green Engineering: Anastas, P.T., and Zimmerman, Env. Sci. and Tech., 2003 - http://www.acs.org/ Home / Green Chemistry Institute / About / Principles / 12 Principles of Green Engineering

12 Principles of Green Chemistry – http://www.epa.gov/greenchemistry/pubs/principles.html

Environmental and Social Performance Principles – http://www.bsdglobal.com/tools/principles_ceres.asp

The Natural Step Framework – http://www.ortns.org/framework.htm

Eco-Machine Principles – http://www.toddecological.com/ecomachines/principles.html

SUSTAINABLE REFERENCES

ENERGY AND GREEN REMEDIATION RESOURCES

EPA Smart Energy Resources Guide – http://www.epa.gov/nrmrl/pubs/600r08049/600r08049.pdf

EPA Introduction to Energy Conservation at Cleanup Sites – http://www.epa.gov/swertio1/tsp/download/epa542s04001.pdf

EPA Green Primer – http://www.cluin.org/download/remed/Green-Remediation-Primer.pdf

State of California, Green Remediation – http://www.dtsc.ca.gov/OMF/Grn_Remediation.cfm

Land Use Planning Tools – http://www.smartcommunities.ncat.org/landuse/tools.shtml

Solar Estimator Calculator – http://www.findsolar.com/index.php?verifycookie=1

SUSTAINABLE REFERENCES

SYSTEM OPTIMIZATION AND PERFORMANCE

Federal Remediation Technologies Cost and Performance Case Studies - http://www.frtr.gov/costperf.htm

Pump and Treat System Evaluation and Optimization – http://clu-in.org/s.focus/c/pub/i/826/

Land Use Planning Tools – http://www.smartcommunities.ncat.org/landuse/tools.shtml

Smart Growth – http://www.epa.gov.dced/

Project Life Cycle, Cost Benefit Analysis, Decision Support Tools – http://www.frtr.gov/decisionsupport/index.htm

SUSTAINABLE REFERENCES

GREEN PURCHASES

EPA's Environmentally Preferable Purchasing – http://www.epa.gov/epp/

Buy-Recycled Series; Construction Products – http://www.epa.gov/osw/conserve/tools/cpg/pdf/construct.pdf

Green Power Partnerships – http://www.epa.gov/grnpower/

Materials and Waste Exchange – http://www.epa.gov/osw/conserve/tools/exchange.htm

SUSTAINABLE REFERENCES

INCENTIVES

State and Federal Alternative Fuel and Vehicle Incentives – http://www.afdc.energy.gov/afdc/incentives_laws.html

State and Federal Renewables and Efficiency Incentives – http://www.dsireusa.org/

Federal Renewable Energy Tax Credits – http://pdf.wri.org/bottom_line_renewable_energy_tax_credits.pdf

Tax Incentives Assistance Program - http://www.energytaxincentives.org/

SUSTAINABLE REFERENCES

TECHNOLOGY

EPA Verified Diesel Retrofit Technology – http://www.epa.gov/otaq/retrofit/verif-list.htm

CARB Verified Diesel Retrofit Technology – http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm

Eco-Patents – www.wbcsd.org/web/epc

Environmental Technologies at the Nanoscale – http://www.nano.gov/html/res/GC_ENV_PaperZhang_03-0304.pdf

SUSTAINABLE REFERENCES

TECHNOLOGY (continued)

12 Sustainable Design Ideas from Nature – http://www.youtube.com/watch?v=n77BfxnVIyc

Top 10 Technologies to Watch – http://www.nano.gov/html/res/GC_ENV_PaperZhang_03-0304.pdf

CO_2 into Stone – http://www.ldeo.columbia.edu/news-events/turning-carbon-dioxide-into-stone

Green Cement – http://bigideas.berkeley.edu/node/135

California Green Chemistry Initiative – http://www.dtsc.ca.gov/PollutionPrevention/GreenChemistryInitiative/index.cfm

SUSTAINABLE REFERENCES

WASTE-TO-PROFIT NETWORKS

Green Power Partnerships – http://www.epa.gov/greenpower/pubs/tools.htm

Green Power Incentives – http://www.epa.gov/greenpower/pubs/incentives.htm

EPA Verified Diesel Retrofit Technology – http://www.epa.gov/otaq/retrofit/verif-list.htm

Low Cost Ways to Reduce Emissions from Construction Equipment – http://www.epa.gov/sectors/pdf/emission_0307.pdf

SUSTAINABLE REFERENCES

SUSTAINABILITY NETWORKING ORGANIZATIONS

AFCEE Sustainable Remediation Tool Development – http://www.itrcweb.org/guidancedocument.asp?TID=42

Cal EPA (DTSC) (Green Remediation Team) – http://www.dtsc.ca.gov/OMF/Grn_Remediation.cfm

CERES (Coalition for Environmentally Responsible Economies) – http://www.ceres.org/page.aspx?pid=705

CLU-IN (Hazardous Waste Clean-Up Information) – http://cluin.org/

EPA (Environmental Protection Agency) (Region 3 + HQ) (Certification proposal) – http://www.epa.gov/superfund/partners/osrti/index.htm

GEMI (Global Environmental Management Initiative) – http://www.gemi.org/GEMIHome.aspx

SUSTAINABLE REFERENCES

SUSTAINABILITY NETWORKING ORGANIZATIONS (continued)

IPCC (Intergovernmental Panel on Climate Change) – http://www.ipcc.ch/

ITRC (Interstate Technology and Regulatory Council) (Remediation Risk Management Green, Sustainable Remediation) – http://www.itrcweb.org/

OSWER/OSRTI EPA (HQ) (Green Primer) – http://clu-in.org/greenremediation/

PERF (Petroleum Environmental Research Forum) – http://www.perf.org/

SuRF (Sustainable Remediation Forum) – http://sustainableremediation.org/

WBCSD (World Business Council for Sustainable Development) – http://www.wbcsd.org/

UK CL:AIRE (Contaminated Land: Applications in Real Environments) (Soil Framework, plus) – http://www.claire.co.uk/

ACKNOWLEDGEMENTS

- Natalie Woodard

  Chevron Environmental Management Company

  Oklahoma Brownfields Conference 2008

  http://www.oklahomabrownfields.com/default.asp?p=etools

CONTACT INFORMATION

- Ann Rosecrance
  Conestoga-Rovers & Associates
  5900 Hollis St, Suite A
  Emeryville, CA 94608
  510-420-3367
  arosecrance@craworld.com

- Kristina McCurdy
  Conestoga-Rovers & Associates
  kmccurdy@craworld.com

www.CRAworld.com

Partners in Sustainability